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EP 0095193 A EP 0027200 A

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(71) Applicant
Mabey Hire Company Limited

(Incorporated in the United Kingdom)

Floral Mile, Twyford, Reading, RG10 9SQ,
United Kingdom

(72) Inventor
John Collins

(74) Agent and/or Address for Service
Marks & Clerk
57-60 Lincoln's Inn Fields, London, WC2A 3LS,
United Kingdom



# (54) Cantilever springs in a strong-box

(57) A strong-box comprises panels interconnected by struts (400) which are connected to the panels (200) by universal joints (500) and also by leaf springs (600). In order for the leaf springs to absorb twisting with the universal joints (500), the springs (600) are split into two side-by-side leaf springs (600a, 600b). At the split (600') the leaf springs (600a, 600b) can accommodate the twisting by separating.

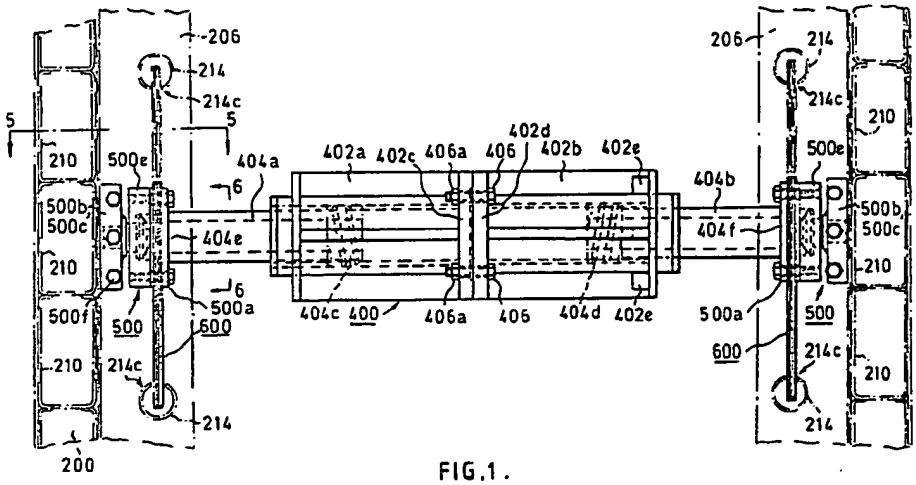


FIG.1.

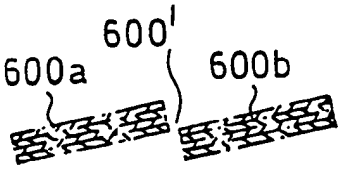


FIG.7.

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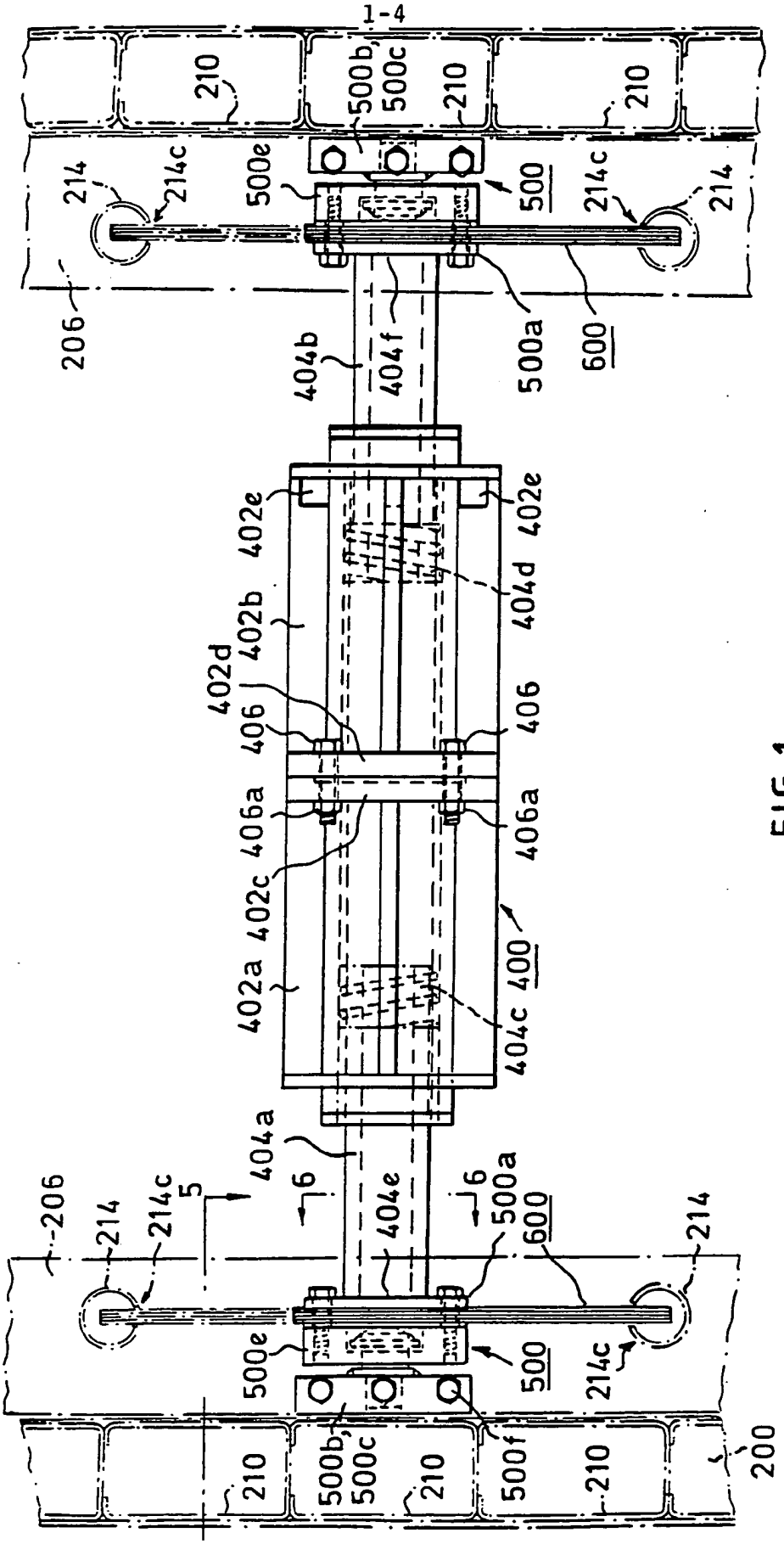
210
500b
500c
210
210
214
214c
500e
500
214c
214
206
404b
404f
500a
600
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402e
402b
404d
402d
406
406
406a
406a
402c
402a
400
404c
404a
6
6
404e
500a
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214
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500b
500c
210
210
500f
210
200

FIG.1.

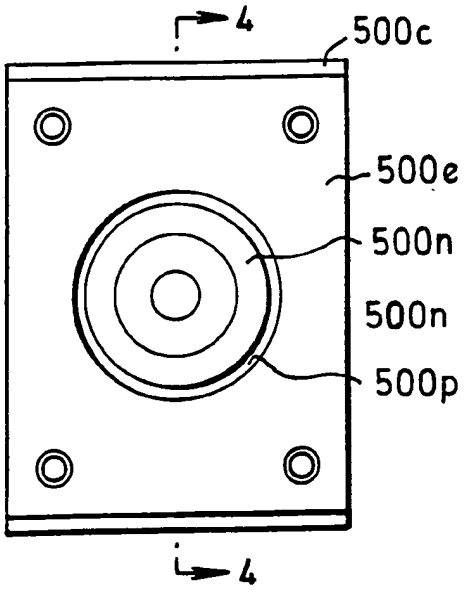


FIG.2.

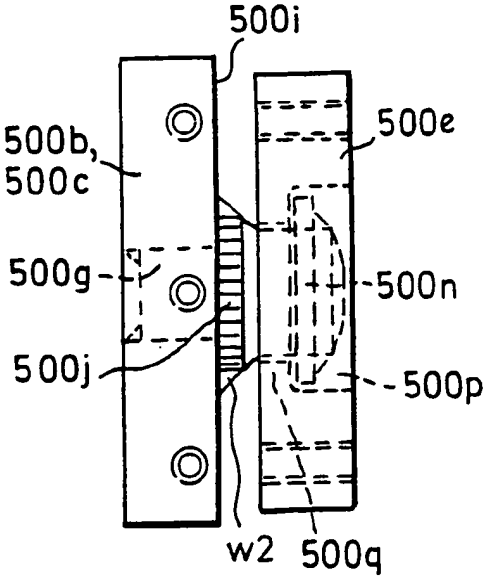


FIG.3.

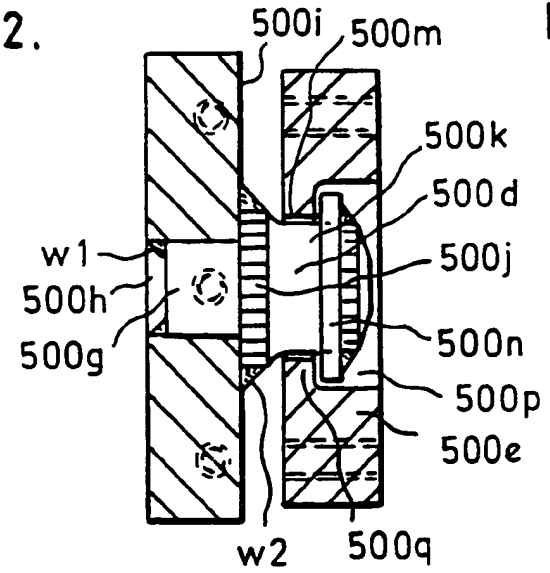


FIG.4.

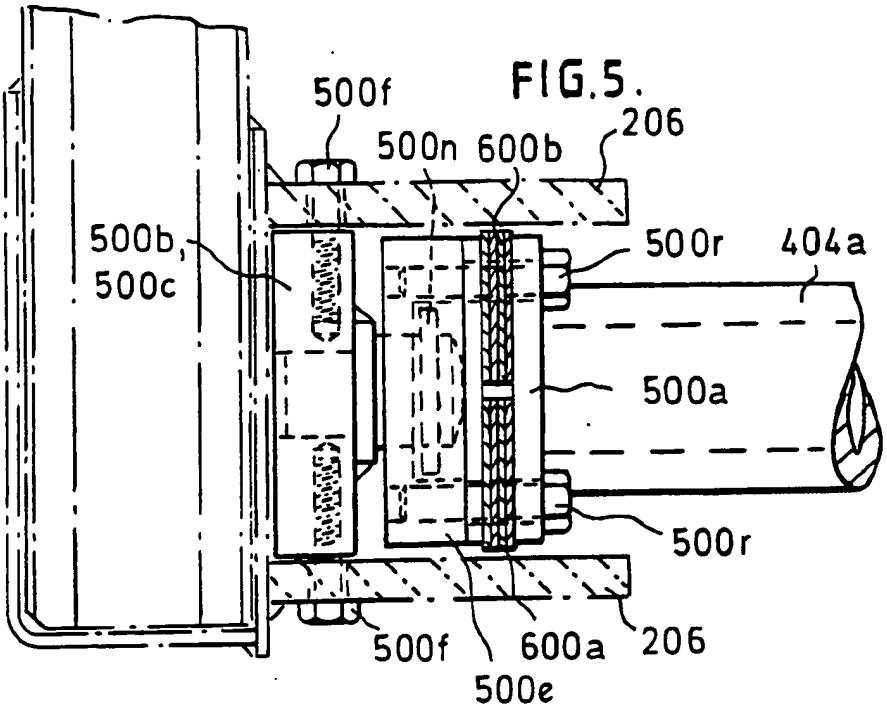


FIG.5.

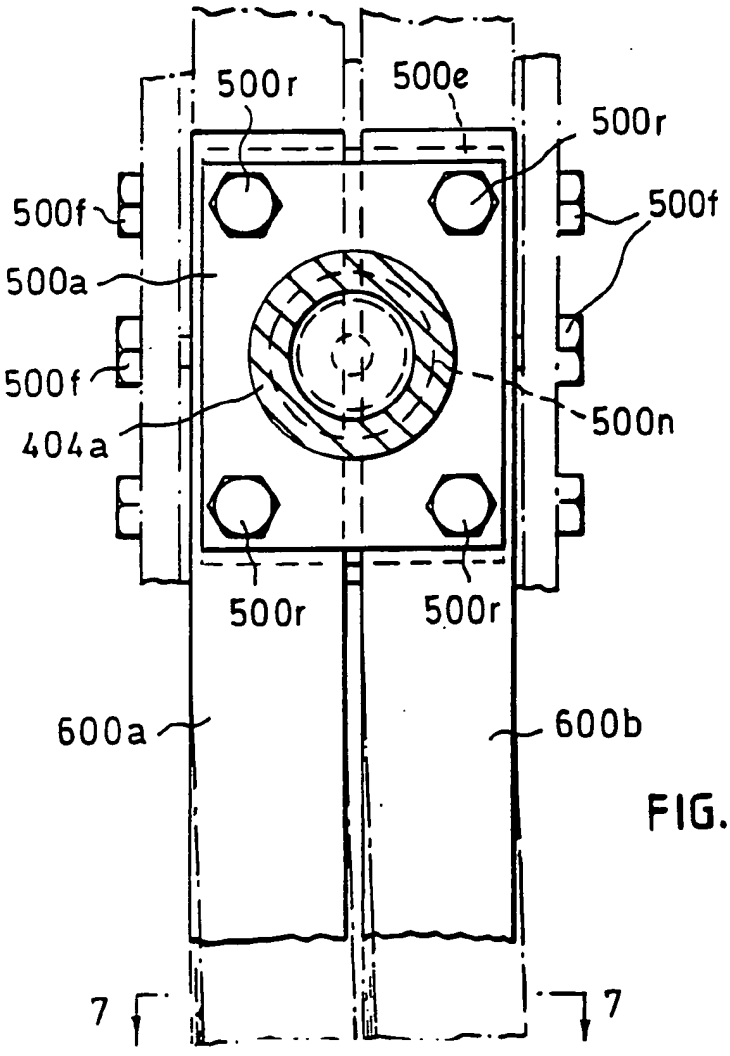


FIG.6.

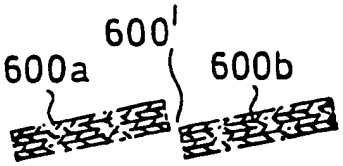


FIG.7.

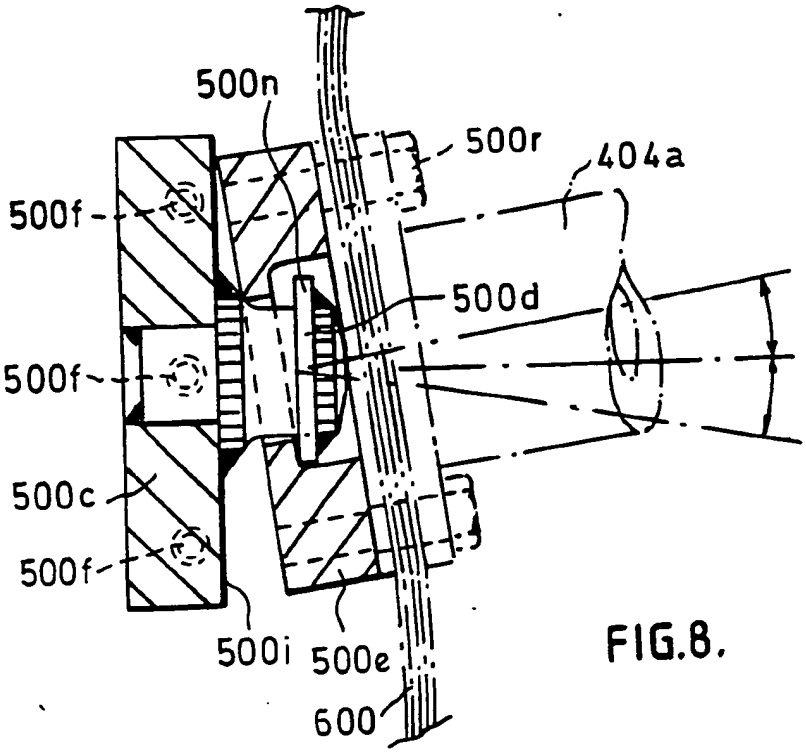


FIG.8.

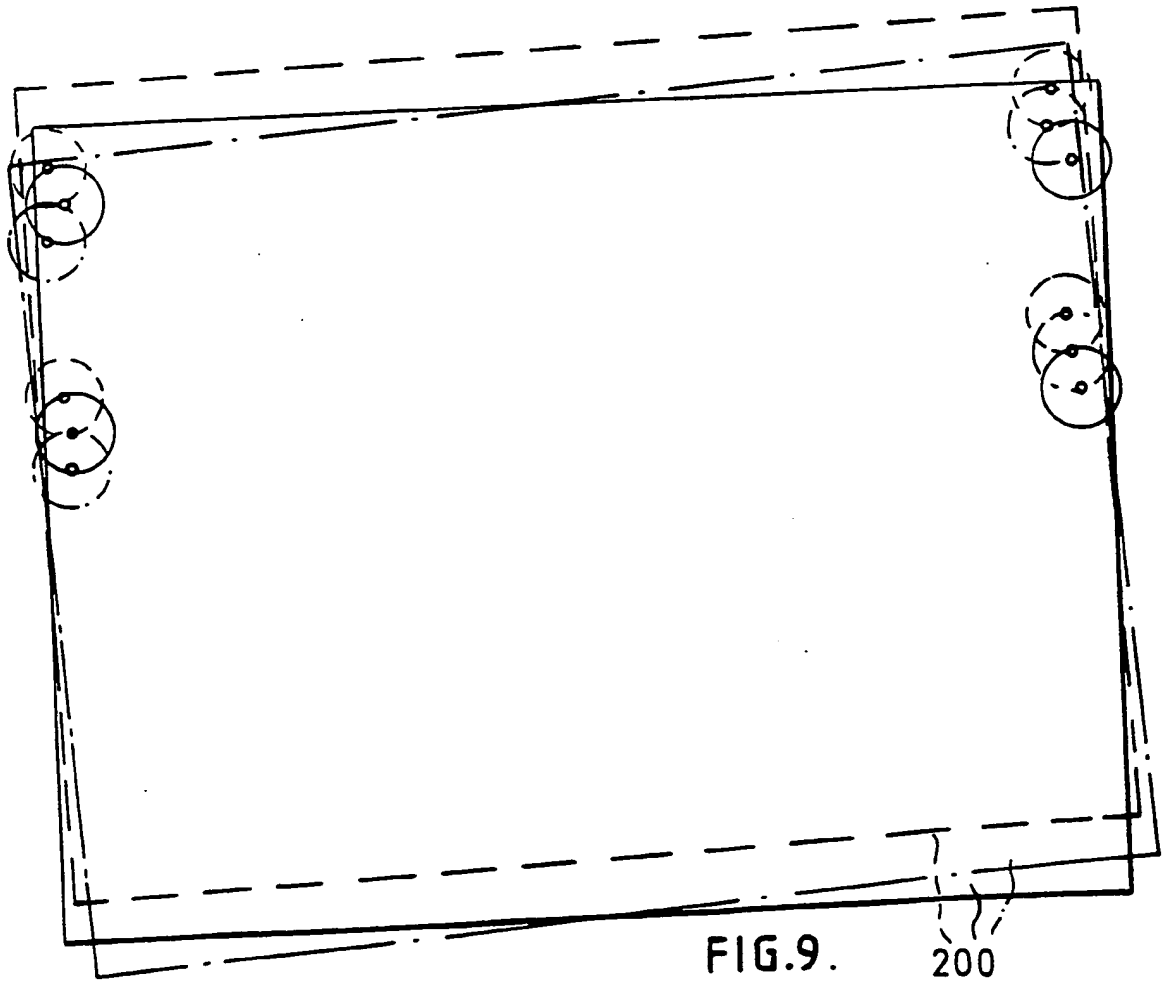


FIG.9.

M&C FOLIO: 230P57730 WANGDOC: 0537f

"CANTILEVER SPRINGS IN A STRONG-BOX"

This invention relates generally to a strong-box. Strong-boxes are used in excavations to shore up the walls.

This invention is one of a series of inventions which are the subject of four co-pending patent applications all filed on the same day by the present applicants. The other three patent applications are as follows:-

patent application No. 8910116 (published as specification No. ) entitled "CONNECTION BETWEEN PANELS IN A STRONG-BOX" - reference 230P57517;

patent application No. 8910176 (published as specification No. ) entitled "STRONG-BOX PANELS" - reference 230P57729; and

patent application No. 8910094 (published as specification No. ) entitled "STRUT-PANEL JOINT IN A STRONG-BOX" - reference 230P57515.

This invention relates to a strong-box comprising a pair of panels interconnected by adjustable struts, opposite ends of each strut being connected to a respective one of the panels by a joint adapted to permit at least a limited range of relative pivotal movement between the strut and the panel.

Such a strong-box is known for use in an excavation to shore-up the sides of the excavation. Considerable force has to be exerted on the panels by the struts, in use. In known strong-boxes, each joint between a strut and a panel is in the form of a pivot which permits pivotal movement about a single axis, usually horizontal, so that either panel can be moved stepwise vertically relative to the other panel.

However, it is found in practice that workers on site, using heavy machinery to move the panels of the strong-box, both during and after use, are liable to distort the strong-box in the difficult process of firstly driving the strong-box down into the excavation and, secondly, afterwards retrieving the strong-box from out of the excavation after use. The distortion of the strong-box frequently involves attempts to pivot the struts, relative to the panels, otherwise than about the

axes of the pivots.

The invention which is the subject of patent application No. 89 (published as specification No. ) entitled "STRUT-PANEL JOINT IN A STRONG-BOX" - reference 230P57515 provides a strong-box comprising a pair of panels interconnected by adjustable struts, opposite ends of each strut being connected to a respective one of the panels by a universal joint adapted to permit at least a limited range of universal pivotal movement in any direction between the strut and the panel.

Preferably cantilever springs also interconnect the panels and the struts, to absorb shocks. However, universal pivotal movement between the panels and the struts inevitably twists the cantilever springs.

It is an object of this invention to provide an arrangement of cantilever springs which avoids this problem. However, the present invention is not limited to use of cantilever springs in such an arrangement.

The invention provides a strong-box as claimed in each of claims 1 to 4, to which reference is directed.

The invention will be described by way of example with reference to the drawings, wherein:

Fig. 1 is a side elevation of part of a strong-box embodying the invention, showing parts of two panels (in phantom) and one interconnecting adjustable strut with two universal joints and leaf-springs;

Figs. 2, 3 and 4 illustrate parts of a universal joint incorporated in the strong-box of Fig. 1, Fig. 2 being a front elevation, Fig. 3 a side elevation and Fig. 4 a section on 4-4 of Fig. 2, respectively;

Fig. 5 is an enlarged fragmentary view on 5-5 of Fig. 1, illustrating one universal joint and side-by-side leaf-springs with parts of one panel and the strut;

Fig. 6 is an enlarged fragmentary view on 6-6 of Fig.1;

Fig. 7 is a section on 7-7 of Fig. 6;

Fig. 8 is an enlarged fragmentary view, partly in phantom, partly in section, of parts of the universal joint, leaf-springs and strut; and

Fig. 9 is a diagrammatic view of a panel being "shuffled" into or out of position.

Referring to the drawings, there are shown two panels 200 (shown in phantom in Figs. 1 and 2) which are as described (with the same references) in patent application No. 89 (published as specification No. ) entitled "STRONG-BOX PANEL" - reference 230P57729.

The two panels 200 are interconnected by struts 400, of which only one strut 400 is illustrated. Each strut 400 is connected to the two panels 200 by two respective universal joints 500 and by two respective sets of leaf-springs 600.

Each strut 400 comprises two bolted together sleeves 402a, 402b and two separate shafts 404a, 404b.

Sleeves 402 are internally screw-threaded, sleeve 402a with a left-hand screw-thread and sleeve 402b with a right-hand screw-thread. Sleeves 402a and 402b are bolted together by bolts 406 (of which only two are shown) with nuts 406a around flanges 402c, 402d of sleeves 402a and 402b respectively. Sleeve 402b has holes 402e therein for receiving a handle (not shown) for turning of the sleeves 402 to extend and retract the strut 400, as will be described.

Inner ends 404c, 404d of shafts 404a, 404b respectively are externally screw-threaded and engage

the screw-threads of sleeves 402a, 402b respectively. It will be realised that the screw-threading of shaft ends 404c, 404d is accordingly left-handed and right-handed.

Hence, the turning of sleeves 402a, 402b by the handle (not shown) inserted in holes 402e extends, or retracts, both shafts 404a, 404b simultaneously out of, or into, sleeves 402a, 402b, depending on the direction of rotation of the sleeves 402.

Outer ends 404e, 404f of shafts 404a, 404b respectively are connected to the two panels 200 respectively by the two universal joints 500. Each universal joint 500 comprises an end-plate 500a welded to the shaft-end 404e or 404f respectively. Each universal joint 500 also comprises a strut-connector 500b. The strut-connector 500b comprises a base member 500c, a peg member 500d and a connector member 500e. The base member 500c is welded and bolted to the panel 200; the peg member 500d is welded to base member 500c; and the connector member 500e is bolted to end-plate 500a and is engaged (as described below) with peg member 500d.

More particularly, the base member 500c is welded to the adjacent C-section member 210 (Fig. 1) of the panel 200 and is also secured by six bolts 500f to an adjacent

one of end-posts 206. An end portion 500g (Figs. 2-4) of peg 500d is tightly seated in a through-hole 500h in base member 500c and is welded to base member 500c at w1 (within the hole 500h) and at w2 (on an inside face 500i of base member 500c). The weld at w2 is around a knurled circular flange 500j of peg member 500d.

A neck portion 500k of peg member 500d extends loosely through a circular aperture 500m in the connector member 500e and is retained by an enlarged flange 500n of peg member 500d. The flange 500n is accommodated in a recess 500p in the connector member 500e. The axial length of the neck portion 500k of peg member 500d is greater than the corresponding length of the flange portion 500q of connector member 500e surrounding the neck portion 500k, so that a limited degree of relative axial movement is possible between the peg 500d and the connector member 500e. Since the diameter of the neck portion 500k is also less than the diameter of aperture 500m, a limited degree of tilting is possible, in any direction, between the peg member 500d (and base member 500c) on the one hand and the connector member 500e on the other hand. Since the base member 500c and connector member 500e are secured respectively to the panel 200 and to the end-plate 500a on the end of the shaft 404 of strut 400, this relative tilting movement is possible between the panel 200 and

the strut 400, so the joint is effectively a universal joint.

Because of the flange 500n on the peg 500d and flange 500q of connector member 500e, the strut 400 is able to pull on the panel 200, to pull the panel 200 away from the face of an excavation in which the strong-box is being used.

In order for the strut 400 to push the panel 200 against the face of the excavation, the inner end 500r of the peg 500d is domed, and is abuttingly engageable by the end-plate 500a of strut 400 through the intermediate leaf springs 600, which are clamped as described above between the end-plate 500a and the connector member 500e, bolted together by bolts 500r.

Because of the universal pivotal movement between the panel 200 and the strut 400, the leaf springs 600 are liable to be twisted. Accordingly, the leaf springs 600 are longitudinally "split" at 600' into two side-by-side cantilever leaf-springs 600a, 600b which can accommodate this twisting movement by separating at the line of split at 80, as shown in Fig. 7. (If the leaf springs 600 are especially wide, they may be "split" into three or more side-by-side cantilever leaf springs - not shown - instead of just two leaf springs.)

The leaf springs 600 may be either "full-length" or "half-length". If half-length, outer ends 600c of leaf springs 600 are received in leaf spring end-connectors 214 through slots 214c therein, whilst inner ends 600d are clamped between the end-plates 500a and the connector members 500e, so as to form cantilever springs. If full-length, as shown in broken lines, opposite ends 600c of springs 600 are received in the connectors 214 and intermediate portions are clamped between the end-plates 500a and the connector members 500e.

In any event, because the cantilever springs 600 are side-by-side, whether single-leaf or plural-leaf springs are concerned, they twist independently of one another around their own axes, and they are less stressed by such twisting than a single cantilever spring of equivalent total width and the same number of leaves would be. The cantilever springs exert a damping action on relative angular movements between the panels 200 and the struts 400, each cantilever spring exerting a restraining action against deviation in any direction from the normal perpendicular orientation of the strut 400 relative to the panel 200.

CLAIMS:-

1. A strong-box comprising two vertical panels connected together by adjustable horizontal struts, each one of two opposite ends of each strut being connected to a respective one of the panels by a respective plurality of side-by-side cantilever springs, each said spring being connected at one place thereof to the respective panel and connected at another place thereof to the strut.

2. A strong-box as claimed in claim 1 wherein each cantilever spring is a leaf spring.

3. A strong-box as claimed in claim 2 wherein the leaf spring is a single leaf spring.

4. A strong-box as claimed in claim 2 wherein the leaf spring is a plural leaf spring.

5. A strong-box as claimed in any one of claims 1 to 4, wherein each cantilever spring is connected at one end thereof to a said panel and at another end thereof to a said strut.

6. A strong-box as claimed in any one of claims 1 to 4, wherein each cantilever spring is connected at two opposite ends thereof to a said panel and intermediate said ends thereof to a said strut.